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Posterior fusion for an unstable axial fracture dislocation

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Abstract

Background: Management of avulsion fractures in the upper cervical spine remains the subject of debate. Currently, most experts favor nonoperative management of an isolated injury. However, these injuries can be complicated by soft-tissue trauma, which may require a different clinical approach to management. Accurate diagnosis of soft-tissue injuries depends on the choice of imaging modality and consideration of unique patient-specific factors.

Case Description: A morbidly obese 34-year-old woman was involved in a low-velocity motor vehicle collision that caused a forceful extension of the cervical spine. Initial computed tomographic imaging demonstrated a displaced avulsion fracture of the C2 body and widening of the C2-C3 facet. However, subsequent imaging using magnetic resonance demonstrated more extensive injuries. Because bracing was not feasible due to cervical instability, the injury was treated with posterior C2-4 fusion and bone grafting.

Conclusions: Even in low-velocity collisions and limited injury on imaging, patient-specific factors should be considered in management decisions. Magnetic resonance imaging showed significant ligamentous compromise and marked cervical instability, revealing potential damage to vulnerable neural structures. Magnetic resonance imaging should be considered in the initial approach to any patient with these injuries.

Key Words: Avulsion fracture, axis, computed tomography, C2 fracture, dislocation, fusion, magnetic resonance imaging, pedicle screw, soft tissue injuries, spinal fractures, vertebral fusion

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INTRODUCTION

Cervical spine injuries can be complex and are commonly associated with significant morbidity and mortality. Isolated fractures of the C2 vertebral body are the most common and are most often caused by extension or hyperextension.[3,6] Due to the complexity and variability in the patterns of injury, appropriate imaging is critical in elucidating the full extent of injury and providing appropriate management. Here, we present a patient with a displaced C2 avulsion fracture complicated by disruption of the ligamentum flavum and anterioposterior longitudinal ligament, partial disruption of the posterior ligamentous complex, and C1/C2 capsule joint disruption.

CASE REPORT

A 34-year-old woman presented with acute onset of neck pain after her car was rear-ended in a low-speed motor vehicle accident. Examination revealed a patient with a body mass index (BMI) of 50, normal

neurological examination, and limited range of motion in the neck. A primary cervical spine computed tomographic (CT) scan showed a displaced fracture involving the anteroinferior aspect of the body of C2, widening of the right C2-C3 facet joint, and a prevertebral hematoma [Figure 1]. These findings prompted magnetic resonance imaging (MRI), which showed disruptions of the anterior and posterior longitudinal ligaments and the right and central posterior ligamentous complex [Figure 2]. A small, ventral, epidural hematoma was noted at C2. These findings, in combination with a developmentally narrow spinal canal, created moderate spinal canal stenosis.

The extensive ligamentous injury prompted surgical stabilization. Surgery involved posterior screw-based instrumentation from C2-C4 using the Mountaineer® OCT Spinal System (DePuy Spine, Inc., Raynham, MA) augmented by a corticocancellous autograft to the decorticated articular surfaces of C2-C3 and C3-C4. Isthmic screws were placed at C2. Additional C2 trans-spinous laminar screws were placed bilaterally through the spinous process into the lamina at an almost perpendicular angle to the initial screw, firmly securing the top end of the construct. Lateral mass screws were placed bilaterally at C3 and C4. At a 6-month follow up, a radiograph of the cervical spine showed a solid fusion [Figure 3]. The patient's neurologic status remained stable.

DISCUSSION

In isolated fractures of the cervical spine, the C2 vertebra is the most commonly fractured.[6] While odontoid fractures and traumatic spondylolistheses of C2 have been extensively classified and characterized, attempts to classify fractures of the C2 body have not been uniformly successful. Three broad patterns of injury have been identified at this level: Those involving the odontoid process, traumatic spondylolisthesis of the axis, and fractures of the vertebral body of C2.[1] One of the more durable classification systems specific to fractures of the body of C2 was proposed by Benzel *et al*.: Type 1 (coronal plane), Type 2 (sagittal plane), and Type 3 (transverse plane).[2]

External immobilization or conservative treatment is recommended for isolated fractures of the body of the axis.[4,5,7] However, this recommendation depends on the stability of the remaining fragments and the absence of significant ligamentous and capsular injury. In our patient, immobilization alone was unlikely to lead to solid osseous fusion between fragments. This case was also complicated by the patient's BMI and short neck that, together, made bracing clinically impractical and

Figure 1: Sagittal CT imaging demonstrating the fracture extending through to the posterior portion of the C2 end plate

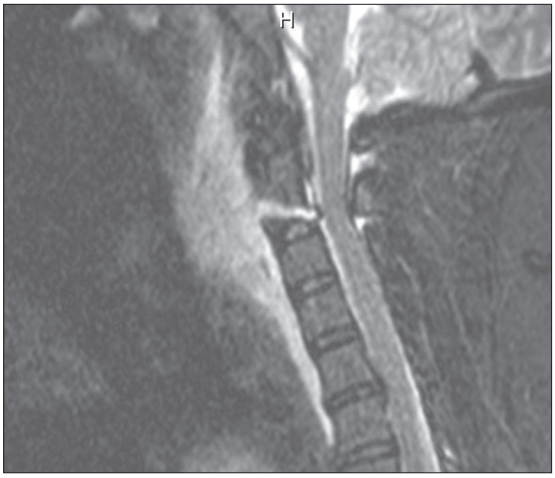

Figure 2: Sagittal MRI demonstrating the extent of the soft tissue injury not apparent of the CT: Narrowed canal, anterior and posterior ligamentous disruption, small epidural hematoma and prevertebral edema

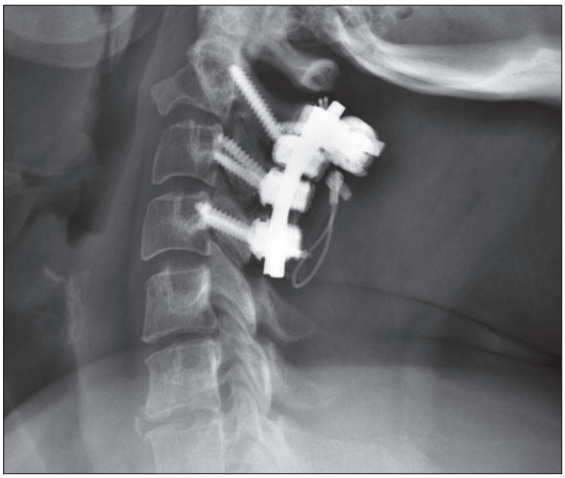

Figure 3: Lateral X-ray demonstrating fusion at C2-4 and good healing of the fracture fragments at 6-month follow up

potentially hazardous. The patient's metabolic profile also predisposed to nonunion, delayed union, and infection.[8] Our surgical approach is noteworthy because it avoids conventional occipitocervical fusion and its attendant complications.[7]

Under the Benzel classification,[2] fracture of C2 would be considered a variant of the type 1 fracture (coronally oriented vertical). However, the extent of ligamentous injury in our patient, which was not apparent on CT imaging, is not accounted for in this classification system.[2] This illustrates the continued difficulty in comprehensively classifying C2 fractures. Accordingly, because these injuries are often associated with additional soft-tissue injury, they warrant additional imaging with MRI.

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